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Circular No. 14

1955

Chemicals and the Meat Industry

By H. R. Kraybill

AMERICAN MEAT INSTITUTE FOUNDATION

939 EAST 57TH STREET • CHICAGO 37

JUNE . 1955

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I am glad to have this opportunity to discuss with you the use of chemicals in the meat industry. Many of the products of the meat industry are among the most perishable foods. Thus our industry must deal continually with the difficult problems that accompany the processing and distribution of highly perishable foods.

The meat industry is interested in new chemical additives which will improve the acceptability or nutritive value or prolong the keeping time of their products. However, we believe that no chemical should be added to foods if there is any reasonable doubt regarding the safety of its use. We feel strongly that it is the duty and responsibility of the industry to demonstrate adequately the safety of its use before any new chemical is added to foods. To obtain the necessary information may require very extensive toxicity and feeding tests with experimental animals. I am sure that your industry is fully cognizant of its responsibility in this respect.

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*Presented at the Meeting of the Commercial Chemical Development Association and the Chemical Market Research Association, Chicago, Illinois, on January 20, 1955.
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Your industry is engaged in developing and finding new uses for chemicals. Perhaps both industries can profit by a greater exchange of ideas.

Although the number of chemicals used in the meat industry is not large, they play an important role in providing highly acceptable and nutritious meat and meat food products for the consumer. When placed in interstate commerce, meat and meat products are subject to the provisions of the Federal Meat Inspection Act. This act provides for controls more rigid in some respects than those of the Federal Food, Drug and Cosmetic Act. First, the Meat Inspection Act requires continuous inspection by means of inspectors located in the different processing plants. Secondly, it provides for inspection of all products used in processing, including ante- and post-mortem inspection of all animals slaughtered. Thirdly, no chemical or additive may be used without prior approval of the Meat Inspection Branch of the Department of Agriculture.

When a new chemical is proposed for use and adequate information is not available regarding the safety of its use in food, the Meat Inspection Branch requires that adequate toxicity and feeding tests be carried out. These proposed tests may be reviewed with the Meat Inspection Branch and representatives of the Federal Food, Drug and Cosmetics Administration before they are undertaken. When adequate information has been obtained to demonstrate safety in the opinion of the Food, Drug and Cosmetic Administration the Meat Inspection Branch may issue a regulation permitting the use of the chemical or additive in certain definite limited amounts.

In addition to safety, certain other criteria may be applied by the Meat Inspection Branch before permission is granted for use of an additive. In general, it must be shown that the additive serves a useful purpose. If the additive tends to hide visible evidence of the quality of a product or to mask the appearance of deterioration or spoilage it may not be

permitted to be used even though safety is not in question.

The chemicals or additives used in the meat industry may be classified into seven groups: (1) Curing agents, (2) Antioxidants, (3) Flavoring materials, (4) Coloring materials, (5) Binders, (6) Sanitation chemicals, and (7) Refining and bleaching agents.

CURING INGREDIENTS

The curing ingredients include salt, nitrate, nitrite, sugars or syrups, phosphates (disodium phosphate, sodium hexametaphosphate, sodium tripolyphosphate, tetra sodium pyrophosphate [$Na_4 . P_2O_7 . 10 H_2O$] and sodium acid pyrophosphate [$Na_2H_2P_2O_7 . 6 H_2O$]), ascorbic acid and sodium ascorbate.

Salt was probably the first chemical used in the curing of meat. Its use in meat preservation undoubtedly began long before we have any historical records. Originally the chief function of salt was to aid in the preservation of meat. With the advent of adequate refrigeration more recently the amount of salt used in curing has been reduced greatly. This has made possible the modern mild cured hams and other products. These cured meats are less stable and must be kept under refrigeration to prevent spoilage. In these products salt functions more as a seasoning agent than as a preservative.

Sodium nitrate and/or sodium nitrite are used in curing in order to obtain the pink color of cured meat. Nitric oxide from the nitrite combines with the pigment myoglobin of meat to form nitric oxide myoglobin. When heated the nitric oxide myoglobin is converted into a more stable form which gives to cured meats the desired pink color. Nitrate must be converted to nitrite before it can function in the development of the cured color.

Nitrate reducing bacteria convert the nitrate to nitrite, but this step in curing is essential only when a straight nitrate cure is employed.

Other than flavor the function of sugars in curing is not completely understood. On a few of the meat foods fermentation of the added sugar helps to provide a reducing condition, which is necessary for color formation and subsequent stability of the color. In the longer cures sugars may play a role in retarding putrefaction in the pickle.

Experiments have shown that it is difficult to distinguish organoleptically hams cured without sugar from those cured with sugar. In cured bacon, sugar may serve to reduce the intensity of the salty taste and thereby contribute to the flavor. Reducing sugars are not suitable for curing bacon because bacon which contains any appreciable amount of a reducing sugar will fry too dark in color.

Ascorbic acid and sodium ascorbate are used to hasten development of the cured color and to increase the stability of the cured color. The different phosphates are used to increase the water holding capacity of the cured meat and thereby increase the retention of the meat juices.

ANTIOXIDANTS

Antioxidants serve a very useful purpose in retarding the development of oxidative rancidity in lard, in shortenings made from animal fats and in animal fats used as an ingredient in dog foods, poultry and livestock feeds. The following antioxidants are approved by the Meat Inspection Branch for use in edible animal fats, and have been used commercially: resin guaiac, nordihydroguaiaretic acid, propyl gallate, butylated hydroxyanisole, butylated hydroxytoluene and lecithin. Nordihydroguaiaretic acid, propyl gallate, butylated hydroxyanisole or butylated hydroxytoluene may be used in amounts not to exceed 0.01 per cent or in combinations in which the

total amount of antioxidants does not exceed 0.02 per cent. Citric acid or phosphoric acid not to exceed 0.01 per cent may be added with the antioxidant.

Suitable antioxidants are added to lard and shortenings made from animal fats to increase the keeping time of the fat during storage and of the foods made with the fat as, for example, crackers, pastry and potato chips. Nordihydroguaiaretic acid, propyl gallate, butylated hydroxyanisole and butylated hydroxytoluene are all effective in protecting the fat from rancidity. But only butylated hydroxyanisole and butylated hydroxytoluene are effective in retarding rancidity in the foods made with lard. It is estimated that at least 50 per cent of the federally inspected lard is now treated with the antioxidant, butylated hydroxyanisole, or combinations containing it.

Shortenings are now being manufactured from animal fats which are equally as satisfactory as the best hydrogenated vegetable shortenings. The use of the process of "rearrangement," the addition of monoglycerides as emulsifiers and of a "carrythrough" antioxidant have made this possible. Since the stability of animal fats after refining and deodorizing was too low for use in a shortening, the meat industry was not able to use these processes in the manufacture of shortenings from animal fats until a suitable antioxidant was available and approved for use. In 1946 twenty million pounds of lard were used in the manufacture of shortenings. In 1953 this figure had increased to 230 million pounds.

Attempts have been made to retard the development of rancidity of bacon and certain types of sausages by the use of antioxidants. Thus far, the results of these experiments have not been very successful.

Large quantities of non-food animal fats (tallow and grease) are now being used as an ingredient in dog food, poultry and livestock feeds. To protect the fat against oxida-

tive rancidity these fats are being stabilized with antioxidants. Dr. Dugan in our laboratories found that the hindered phenols, like butylated hydroxyanisole and butylated hydroxytoluene, are most effective in retarding rancidity in fats added to feeds. The addition of antioxidant-treated animal fats to mixed feeds and to dehydrated alfalfa has been shown to decrease the loss of carotene and vitamin A. Experiments are now underway in our laboratory to compare the effect of animal fats treated with different antioxidants on the stability of carotene and vitamin A in mixed feeds.

FLAVORING MATERIALS

A large number of natural spices and so-called soluble spices or spice extractives are used in the large variety of sausages and prepared meats. Protein hydrolyzates and monosodium glutamate are used to some extent.

Monosodium glutamate is believed to act as a salt-type of seasoning rather than as a condiment possessing a distinctive flavor.

COLORING MATERIALS

The natural coloring matters, alkanet, annatto, carotene, cochineal, green chlorophyll, saffron and turmeric and a number of dyes certified under the Food, Drug and Cosmetic Act for use in connection with foods are permitted for use under certain conditions by the Meat Inspection Branch.

Of particular interest at this time is the recent announcement of the intention of the Food, Drug and Cosmetic Administration to remove from certification three dyes used by the meat industry to color sausage casings. These dyes are F D & C Orange No. 1, F D & C Orange No. 2, and F D & C Red No. 32. The meat industry would like to have harmless colors that will duplicate the colors of those removed from certification. While there are available certain coloring

materials that can be used, they are not entirely satisfactory and do not provide the same shades of color.

SAUSAGE BINDERS

Certain approved cereals, vegetable starch, starchy vegetable flour, soya flour, non-fat milk solids and dried milk may be used in sausage in an amount not more than 3.5 per cent individually and collectively. An appropriate declaration of such additions is required on the label of the product.

DETERGENTS AND CLEANING COMPOUNDS

The types of detergents and cleaning compounds used by the meat industry have been described in a recent pamphlet entitled "Cleaning and Sanitizing Methods and Materials for the Meat Packing Plant" issued by the American Meat Institute. The following description of the types of cleaning compounds commonly used is quoted from the pamphlet:

1. General Alkaline Cleaner (containing proper balance of such materials as trisodium phosphate, complex polyphosphates, sodium metasilicate, soda ash, and wetting agents). These are used as general cleaning agents to remove product soil, etc. Formulations may be varied according to the hardness of the local water supply.

2. General Heavy Duty Alkaline Cleaner (containing balanced amounts of caustic, metasilicate, trisodium phosphate, and/or complex polyphosphates). Wetting agents may be added. It may also be used in alternate cleaning (acid and then alkali) and for removal of many types of water-insoluble soils or films difficult to remove.

3. General Inorganic Acid Cleaners (containing proper amounts of materials such as sodium acid phosphate, sodium acid sulphate, sodium sulphate, phosphoric acid, and/or citric acid and of wetting agents). Used for removal of metallic

corrosion and hard-to-remove protein and water hardness film deposits from belly dry cure metal boxes, trimming cans, metal trucks, meat trimming tables, and similar equipment.

4. Heavy Duty Inorganic Acid Cleaner (containing proper amounts of hydrochloric acid (muriatic acid), an inhibitor such as formaldehyde, and perhaps some wetting agent). Used for removing stain, scale or deposit from such things as porcelain fixtures in locker and dressing rooms.

5. Abrasive Cleaners (optional) (General type alkaline cleaners with a large precentage of volcanic ash, silica or feldspar abrasive of proper mesh size. A good household cleanser may be purchased and used for this purpose). Used with proper scrubbing brushes for removal of hard-to-remove protein-carbohydrate-water hardness deposits. When selecting an abrasive cleaner consideration should be given to the type of surface to be cleaned and the degree of abrasion which is tolerable.

REFINING AND BLEACHING AGENTS

The following chemicals and materials are permitted for use in the refining of animal fats: sodium bicarbonate, sodium carbonate, caustic soda, acetic acid, tannic acid, diatomaceous earth, Fuller's earth and carbons. Caustic soda, sodium carbonate, trisodium phosphate, sodium metasilicate lime and a solution of hydrogen peroxide may be used in preparation of tripe. The added substances must be removed by washing thoroughly in water.

PRESERVATIVES

Sodium benzoate or benzoic acid in quantity not to exceed 0.1 per cent of the weight of the finished products may be used in oleomargarine. No preservatives are permitted in other meat products for domestic use.

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